

Honolulu High Capacity Transit Corridor Project (HHCTC)

Schedule Review

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Table of Content

1. Executive Summary2

2. Project Background.....~~45~~

3. Methodology.....~~67~~

4. Review and Assessment of Project Schedule.....~~710~~

 4.1. Overall Review.....~~710~~

 4.2. Project Phases~~916~~

5. Conclusion~~1726~~

APPENDIX A – Major Activity/Milestone Forecast Dates~~1929~~

1. Executive Summary

Kal Krishan Consulting Services, Inc. (KKCS), as a subconsultant to Booz Allen Hamilton (Booz Allen), reviewed and assessed the Working Schedules for the Honolulu High-Capacity Transit Corridor (HHCTC) Project submitted by the City and County of Honolulu as of September 21, 2008. The purpose of the review is to

- Provide an overview of the working schedules prepared by the City
- Determine if the major items in the individual schedules are incorporated into the consolidated project schedule submitted on September 21, 2008
- Assess whether the consolidated project schedule is sound and technically correct, and
- Determine if this consolidated project schedule was acceptable as a Master Schedule for the project as requested by FTA.

The review of the schedules indicates that major items in the individual schedules are not incorporated into the consolidated project schedule, ***and that the consolidated project schedule as provided on September 21, 2008 is not acceptable as a Project Master Schedule.***

The three schedules provided by City are at the preliminary planning stage. The schedule depicts an optimistic but achievable revenue service date of December 2018 for the entire alignment. Although the Phase 1 and Phase 2 schedules are mechanically sound, KKCS notes that further development will enhance the Phase 1 schedule's usefulness as a management tool, particularly since durations and the overall schedule are optimistic. KKCS also suggests the addition of more detailed activities and relationship ties, especially in the final design and construction phases.

The City should start working on a Master Schedule which should incorporate all of the schedule activities in the three schedules and provide uniform schedule data information. The schedule needs further technical development in order to provide a sound basis to manage the project to these very tight durations. These include:

- Use the same scheduling software for the Master Program Schedule and the individual schedules used by the city, consultants, and contractors.
- Define detail project scope and prepare a Contract Implementation Plan that identifies and describes the contract packages and provides the framework for the execution of design, procurement and construction in the HHCTC project.
- Assure a project schedule development and implementation procedure is developed and implemented by all staff/consultants.
- The PMOC/FTA review and approval processes and duration are not clearly depicted in the schedules.
- Identify clear relationship ties between land acquisition, utility relocation, DMU vehicle procurement, civil/systems D/B, station final design and construction. This effort will also result in the identification of additional critical path items.
- Include system start-up activities such as system integration, dynamic testing and pre-revenue operations with a minimum nine month duration for these activities.
- Additional detailing of guideways, stations and systems construction activities.

- Inclusion of duration contingencies to address further activity detailing as the design and construction phases progress, without impacting to the Revenue Operations Date.
- Include additional detail for long-lead Owner furnished equipment and material.
- A logic driven schedule (versus a constraint/open-end ties schedule) is a necessary tool to manage this overall aggressive schedule to a successful conclusion.

Due to the aggressive nature of the Phase 1 schedule, early risk identification and elimination is imperative to the City's ability to achieve the revenue service date. KKCS recommends the following measures in this regard:

- Assign a project-wide coordination team knowledgeable in rail construction and operations to coordinate the project during design, construction and start-up phases.
- Perform timely procurement of the major real estate parcels and special attention to avoiding the condemnation process.
- Coordinate closely with utility companies to relocate critical utility lines in advance of construction start; and timely execution of third party agreements.
- Conduct regularly scheduled design coordination meetings with Phase 1 design/build contractors for guideways, stations, systems, and yards & shops engineers to identify design/coordination issues.
- Advance the completion dates for guideways, stations, and systems work earlier than currently planned, allowing more time for system integration, dynamic testing, and pre-revenue operations.
- Contingency plan to mitigate price increases for material and labor.

2. Project Background

The HHCTC Project is a 29-mile elevated fixed guideway system along O'ahu's south shore between Kapolei and the University of Hawai'i (UH) at Mānoa, including a spur to Waikīkī.

In July 2005, the state legislation authorized a 0.5-percent General Excise and Use Tax (GET) Surcharge as a source of revenue to build the transit corridor project. The GET surcharge went into effect on January 1, 2007 and has an end date of December 31, 2022. An Alternatives Analysis (AA) was initiated in August 2005 and the AA report was presented to the Honolulu City Council in October 2006. Public meetings were held on the AA in November and December 2006, and on December 22, 2006, the City Council selected the fixed guideway alternative as the LPA. In selecting fixed guideway as the LPA, the City Council left some areas of the alignment open, which will be decided upon as the project progresses. These include West Kapolei, Salt Lake Boulevard versus Airport alignment, and the Waikīkī/UH at Mānoa branches. The total LPA alignment is approximately 29 miles long from end to end.

The City Council also identified and selected a minimum operable segment ("the First Project"), which would be built first with the current funding/revenue available. This "First Project" is a 19-mile alignment from East Kapolei, through Salt Lake Boulevard and downtown, and with an eastern terminus at the Ala Moana (Shopping) Center. The "First Project" does not include the alignment from West Kapolei to East Kapolei, or from Ala Moana Center to Waikīkī or to the UH at Mānoa.

The "First Project" is divided into two phases. Phase I is approximately 6 miles long and includes 6 stations. The proposed limits of Phase I are from the future site of the Kroc Center development at North-South Road to the vicinity of Pearl Highlands. Phase II encompasses the remaining 13 miles and 13 stations, and is from Pearl Highlands through Salt Lake Boulevard and downtown, with an eastern terminus at the Ala Moana (Shopping) Center.

On July 1, 2007, the City created the Rapid Transit Division (RTD) within the Department of Transportation Services (DTS) through enactment of the City's Fiscal Year 2008 Executive Operating Budget and Program. The RTD's responsibilities will include project development, management and implementation. New staff members continue to be added to the City's organization within RTD and through InfraConsult, LLC, the City's Project Management Support Consultant (PMSC). The City has started advertising the positions currently performed by InfraConsult, LLC.

On August 24, 2007, the City executed a General Engineering Consultant (GEC) contract for \$85 million with PB Americas, Inc. (PB) to perform National Environmental Policy Act (NEPA) documentation and PE activities. The City combined the activities needed to support NEPA and conduct PE into the GEC contract with separate Notices to Proceed (NTPs).

On April 17, 2008, the Mayor directed DTS to move forward with steel-wheel on steel-rail technology. The City is currently developing the DEIS and advancing into PE based on steel

wheel on steel-rail technology. At present, the City intends to request entry into PE by the end of 2008.

The City intends to implement the project using an incremental approach as shown in Figure 1. It is the City's intent to perform the final design and begin construction of the initial phase of the "First Project" (Phase I) after the Record of Decision (ROD) is issued using a design-build method of delivery with local funds. Phase I is scheduled to be in operation at the end of 2012.

Phase II is comprised of the remaining limits of the "First Project", Segments D, E and F. Phase II could be opened in phases as construction is completed; the final section of the "First Project" is scheduled for operation in 2017, five years after Phase I is placed into service. The City is evaluating other options, such as Phase I operations on a demonstration basis during limited hours. The City is currently developing the Master Schedule for project delivery which outlines this approach.

On August 1, 2008, the City issued the Administrative DEIS to FTA for review and comment. The Administrative DEIS includes three fixed guideway build alternatives:

- Salt Lake only
- Airport only
- Airport and Salt Lake

The Salt Lake alternative is currently being evaluated for entry into PE.

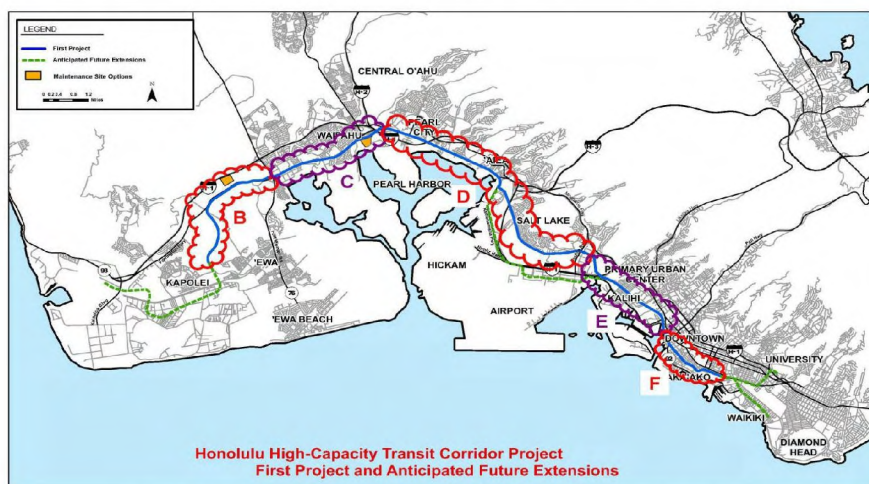


Figure 1. First Project and Anticipated Future Extensions

3. Methodology

Kal Krishan Consulting Services, Inc. (KKCS), as a subconsultant to Booz Allen Hamilton (Booz Allen) reviewed and assessed the Working Schedules for the Honolulu High-Capacity Transit Corridor (HHCTC) Project submitted by the City and County of Honolulu as of September 21, 2008. The purpose of the review is to:

- Provide an overview of the working schedules prepared by the City
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- Determine if this consolidated project schedule was acceptable as a Master Schedule for the project as requested by FTA.

The following files were used by KKCS, provided by Booz Allen and the City, for the schedule review:

1. PE/EIS Schedule: P6 schedule file Salt Lake Constr (Data Date: 11DEC07; file: HHCTCP As of August 25.xer)
2. Consolidated project schedule: P3 schedule file CITY (Data Date: 15SEP08; file: CITY.prx)
3. Linear construction schedule: PMOC2 – Honolulu Linear Schedule 07 Aug 08.pdf
4. PMOC – day 1.ppt Slide 9 Project Phasing dated 12SEP08
5. PMOC – day 2.ppt Slide 8 Procurement Schedule dated 16SEP08

4. Review and Assessment of Project Schedule

The assessment includes a review the City's schedule components such as activity durations and logic relationships, and provide a professional opinion as to the validity of meeting the revenue operation date of December 2012 for the Farrington alignment and September 2013 for West Oahu alignment. Review comments and recommendations included in this assessment are based on past similar experience that includes the Los Angeles Eastside Extension LRT, Sacramento South Corridor LRT, SEPTA Market Street Elevated Guideway, Seattle Link LRT, and other projects. Scope and construction attributes that are unique to the HHCTC Project are considered as well, including the design/build delivery.

The majority of the review time was focused on the general project flow of the activities from Preliminary Engineering through Final Design, Construction, and Systems Startup-up/Testing. A cursory review of the technical aspects was done, to include scheduling software, activity coding, and the WBS structure. The technical aspects of the schedule need to be further developed to facilitate a more detailed review.

4.1. Overall Review

KKCS's review of the working schedules in the ProjectSolution website directory indicates there is no roll-up of individual schedules into a consolidated project schedule. For example, each individual schedule forecasts different start and finish dates for the same design/construction activities. KKCS also notes that the schedule lacks clarity in defining the design and construction sequence of activities; the durations of the identical design/construction activities among the three schedules differ.

Prior to reviewing the schedule details, KKCS reviewed the Draft Working Schedule from an overall project milestone perspective. The significant project milestone dates are included as Appendix A.

Major observations of the PE/EIS Schedule, Linear Construction Schedule, and the Consolidated Project Schedule are as follows:

- All three schedule have different forecast dates; however the schedule dates in the Linear Schedule matches more closely with the Consolidated Project schedule dates.
- The general work flow structure is better reflected in the P6 Salt Lake Constr *file* (PE/EIS Schedule), showing a more workable sequence from preliminary engineering, final design, procurement, utility relocation, guideway, station, and systems installation. However, the schedule dates are different *compared to* the Consolidated Project and Linear Schedule data.
- All three schedules do not have start-up activities for static testing, dynamic testing, and pre-revenue operations.

- KKCS concurs with the City's utilization of the linear schedule method for project planning; this method should continue to be utilized to monitor/update the project with latest information and detail.
- The Project Work Break-Down Structure (WBS) was not available in the web database.
- The construction schedule assumptions in Assumptions.xls file contains more details than the "Constr Sche Assumption Notes".pdf file.
 - KKCS notes these files need to be reconciled and further developed.
- Real estate acquisitions and utility relocations have a typical duration of one year. The real estate acquisition information should be tied with the database from the Real Estate and Acquisition Management Plan (RAMP). Utility relocations by public agencies and private companies require additional research, investigation, design, and relocation prior to the Guideway, Station and Yard & Shop construction.
- KKCS notes that construction activity descriptions should be uniform. For example, the Yard & Shop Facility is also shown as the Maintenance Storage Facility (MSF).
- Currently P3, P6 Primavera Systems are being utilized for the schedule development.
 - KKCS suggests the City require all city agencies, consultants, contractors, and suppliers to utilize the same scheduling software for more efficient and effective schedule maintenance and interface. Since a Master Program Schedule needs to be developed, KKCS recommends P6 software.
- The Readiness for Preliminary Engineering Schedule and EIS schedule activities in the Consolidated Project Schedule file have been well defined and offer sound logic ties.
- HHCTC's Advance Conceptual Engineering for Guideways, Stations, Systems and Yard & Shops activities should have progressed to a typical Preliminary Engineering 50% design completion stage due to preparation of project documents for the Design/Build contract package.
 - At this stage, KKCS notes a Program Coordinator function should be in place as an interface point between the Guideways, Stations, Systems, Yard & Shops, Operations Control Center (OCC) and Static/Dynamic testing design development.
 - At this phase, there should also be a coordinator who will oversee the real estate, and private/public utilities with the civil plans.
- Before issuing the Notice to Proceed (NTP) to the Design/Build Contractor(s), the real estate acquisition process and the utility relocation process should be completed in the construction area.
 - KKCS notes the potential necessity for a Letter of No Prejudice (LONP) in order to advance real estate acquisition and utility relocations in advance of the Full Funding Grant Agreement (FFGA).

- The PMOC/FTA review and approval processes and duration are not clearly depicted in the schedules.
 - These activities should be included in the Master Schedule to assure this effort and associated time requirements are coordinated adequately.
- The schedules do not identify interface points/requirements between utility relocation, sitework, guideway, stations, trackwork, contact rail, train control, communications, yard & shops, OCC, static/dynamic testing, pre-revenue operations, vehicle delivery and revenue operations.
- The schedules do not identify Owner furnished long lead items such as running rails, special trackwork, contact rail systems, fiber optics/cables, elevator/escalator, and track maintenance equipment.
- All three schedules do not have line items for testing rail cars at the test track.
- The Operations Control Center (OCC) is identified in the P6 Communication section, but the schedules do not have the location and activities for the facility construction and equipment installation.
- The overall HHCTC project duration is ten (10) years.
 - KKCS recommends that a thorough evaluation of grantee escalation assumptions be done as a part of the cost review process. The review should focus on concrete, steel, running rail, labor, and other major items.

4.2. Project Phases

The schedules organizes the HHCTC project into following MOS phases (Based on the HHCTC Linear Schedule schedule).

- 1 Farrington Segment – Line opens DEC12
- 2 West Oahu Segment – Line opens SEP13
- 3 Kamehameha Segment – Line opens NOV16
- 4 Salt Lake Segment – Line opens MAY18
- 5 City Center Segment – Line opens DEC18

Based on guideways construction start in October 2009, 39 months from construction to revenue services for the Farrington Minimum Operable Segment (MOS) is very aggressive. KKCS makes the following recommendations:

- The Farrington Line begin service in concert with the West Oahu Segment which has a total duration of 48 months of construction. The additional time gained results in a more realistic schedule for the initial segment, and also provides a more reasonable window for the Yard & Shop maintenance staff to go through training, rail car testing, and pre-revenue service before the initiation of revenue operations.

- The City consider concurrent start of revenue service for the Salt Lake and City Center segments, as there are only about seven (7) months difference between the two as currently planned.

4.2.1. Pre-Preliminary Engineering/Advance Conceptual Engineering

Major Activity/Milestone Forecast Dates:

| | |
|---|-----------------|
| P3 CITY – FTA Approves PE | 31DEC08 |
| P3 CITY – DB MSF Project Documents | 14JAN09-30JAN09 |
| P3 CITY – DB Guideway Project Documents | 16SEP08-13JAN09 |
| P6 – Advanced Conceptual Eng West Oahu | 11DEC07-17MAR09 |
| P6 – Advanced Conceptual Eng Farrington | 18FEB08-17FEB09 |
| P6 – Advanced Conceptual Eng Yard & Shops | 27MAY08-26NOV08 |

Review Comments:

Based on the schedule activities break-down and packaging, it appears that each segment is considered to be a separate package. However, when opening a MOS segment for operations, the project needs to interface with all components such as guideways, stations, train control, traction power, radio, PA/CCTV, SCADA, static/dynamic testing, rolling stocks, OCC and Yard & Shops.

KKCS notes the City should consider implementing a Project Coordinator who would be responsible for managing all of these interfaces contract/activities during the design and construction phases. At this point, KKCS does not see evidence that the City has the proper tools to manage this interface effort and work among the different components.

4.2.2. Right of Way and Utility Relocation

Major Activity/Milestone Forecast Dates:

| | |
|---------------------------------------|------------------------|
| P3 CITY – Identify ROW Parcels | 15NOV08 (2 mos) |
| P6 Salt Lake Constr – ROW Acquisition | 17AUG09-22DEC11(16mos) |
| P6 West Oahu – Utility Relocation | 09OCT09-20JUL10 (9mos) |
| P6 Farrington – Utility Relocation | 18JAN10-12OCT10(9mos) |
| P6 Yard & Shop – Utility Relocation | No activities |
| P3 CITY – Issue NTP DB MSF | 01MAR10 |
| P3 CITY – Issue NTP DB Guideway | 17JAN10 |
| P3 CITY – Issue NTP DB Systems | 25APR10 |

Review Comments:

The 16-month duration to appraise, relocate, and acquire required real estate seems reasonable, and special attention should be given by the City to avoid the condemnation process for major parcels required for construction. Before issuing the NTP to the Design/Build contractors, the real estate acquisition required for the contracts should be completed to assure there are no delays in this regard.

KKCS notes that the P6 schedule (PE/EIS Schedule) appears to combine utility relocation work with the Guideway contractor, but there is no utility relocation activity in P3 CITY (Consolidated) file schedule. The City will have to determine a consistent approach, and whether to combine the utility relocation work with the D/B package or as a separate package before starting Guideway construction. Extensive coordination work will be required with private utility companies.

4.2.3. Preliminary Engineering (PE)

Major Activity/Milestone Forecast Dates:

| | |
|------------------------------------|-------------------------|
| P3 CITY – Issue Record of Decision | 28AUG09 |
| P3 CITY – Preliminary Engineering | 31DEC08-26DEC09 (12mos) |
| P3 CITY – FTA Award FFGA | 20FEB11 |

Review Comments:

The schedule activities for the Readiness For Preliminary Activities and EIS in the P3 CITY (PE/EIS) schedule are well prepared and provide an adequate basis to monitor progress. However, Preliminary Engineering activities should be broken down in detail and depict relationships between the Advance Conceptual Engineering, Design./Build packages and Final Design.

4.2.4. Long Lead Procurement Items

Major Activity/Milestone Forecast Dates:

None

Review Comments:

The City has not provided any information in the schedule regarding the long lead procurement items that are often procured by the Owner and furnished to the contractors for installation. In the Procurement Packaging PowerPoint slide, the City is planning to procure elevators/ escalators and fare equipment. Some examples of the long lead procurement items are as follows:

- Running rails
- Special trackwork
- Contact rail system
- Fiber optic/cables
- Elevator/Escalator
- Track Maintenance Equipment

4.2.5. Guideways

Major Activity/Milestone Forecast Dates:

| | | |
|---|---------|-----------------|
| P3 CITY-West Oahu/Farrington Gway DB Contract | 17JAN10 | 16MAR12 (26mos) |
| Linear Schd-Farrington Guideways | OCT08 | SEP11 (36mos) |

Linear Schd-West Oahu Guideways

NOV08

DEC11(38mos)

Review Comments:

In general, the duration for the construction of guideways appears to be sufficient. However, the City should show relationships between utility relocation work, station construction, and systems installation. If the guideway is to be built at-grade in lieu of the elevated spans, then detail construction activities for the at-grade work should be provided.

As a result of the review, KKCS identified several areas that require additional clarification:

- Where will the fabrication facility be that will produce the elevated spans and has there been a study regarding delivering the spans from the fabrication facility to the construction site?
- Who will coordinate design issues between guideway, stations, systems, and testing?
- Who will coordinate issues during construction?
- Where will the staging area be for trackwork, signal, and radio/communication?
- Which contractor will be responsible for system start-up – system integration, dynamic testing, and pre-revenue operations?

4.2.6. Stations

Major Activity/Milestone Forecast Dates:

| | | |
|--|---------|----------------|
| P3-West Oahu Stations Construction | 17JAN12 | 16APR14(27mos) |
| P3-Farrington Stations Construction | 23MAR11 | 10APR14(36mos) |
| P6-West Oahu Station Construction | 01JUL11 | 30AUG13(25mos) |
| P6-Farrington Station Construction-WestLoch&Pearl High | 01FEB11 | 30AUG13(30mos) |
| Linear-Farrington Stations | JUL11 | SEP13(27mos) |
| Linear-West Oahu Stations | SEP11 | SEP13(25mos) |
| Linear- Farrington Line Opens | | DEC12 |
| Linear-West Oahu Line Opens | | SEP13 |

Review Comments:

The duration of 25 to 36 months for the design and construction appears optimistic but can be achievable. The schedules do not show station contractors providing access to systems contractor to install train control equipment, communication equipment room, PA/CCTV, Fire & Emergency Management Systems, Radio, Sub-station, Elevator/Escalator and Mechanical Room, etc. All these systems have to be installed before the static test can start.

4.2.7. Trackwork & Rail Contact Systems

Major Activity/Milestone Forecast Dates:

| | | |
|--------------------------------------|---------|----------------|
| P6-Trackwork Advanced Conceptual Eng | 08DEC08 | 06AUG09(8mos) |
| P6-Trackwork Final Design | 28JUN10 | 19OCT10(15mos) |
| P6-Trackwork Fabrication | 20OCT10 | 09DEC11(14mos) |
| P6-Trackwork West Oahu | 02JAN12 | 31AUG12(8mos) |

| | | |
|---|---------|----------------|
| P6-Trackwork Farrington | 04APR11 | 30DEC11(9mos) |
| P6-Trackwork Yard & Shop | 16JUL12 | 08FEB13(6mos) |
| P6-Trackwork Kamehameha | 01OCT13 | 25NOV14(14mos) |
| P6-Trackwork Salt Lake | 25NOV14 | 29FEB16(15mos) |
| P6-Trackwork City Center | 29FEB16 | 26JUN17(16mos) |
| P6-Traction Power Advanced Conceptual Eng | 08DEC08 | 06AUG09(8mos) |
| P6-Traction Power Final Design | 28JUN10 | 19OCT10(15mos) |
| P6-Traction Power Fabrication | 20OCT10 | 09DEC11(14mos) |
| P6-Traction Power West Oahu | 27FEB12 | 12APR13(14mos) |
| P6-Traction Power Farrington | 30MAY11 | 11OCT12(16mos) |
| P6-Traction Power Yard & Shop | 09MAR12 | 12JUL13(15mos) |
| P6-Traction Power Kamehameha | 25DEC13 | 16SEP16(33mos) |
| P6-Traction Power Salt Lake | 20JAN15 | 16FEB18(38mos) |
| P6-Traction Power City Center | 29FEB16 | 16NOV18(33mos) |
| Linear-Farrington Trackwork | FEB11 | NOV11(10mos) |
| Linear-Farrington Traction Power | FEB11 | SEP12(20mos) |
| Linear-West Oahu Trackwork | NOV11 | AUG12(10mos) |
| Linear-West Oahu Traction Power | FEB12 | JUN13(17mos) |

Review Comments:

The duration for the trackwork installation appears achievable but seems somewhat aggressive for the trackwork at the Yard & Shop. In the HHCTC linear schedule, the installation of the traction power lags about 6-12 months after the installation of the running rail. In general, if the system is third rail system (contact rail system), installation of the contact rail goes in tandem with the track installation.

As a result of the review, KKCS identified several areas that require additional clarification:

- Where will the running rails be stored before installation?
- Where will be the staging area for the trackwork? (Staging at the yard and shops needs to be verified.)
- If the yard and shop will be the storage and staging area for the trackwork and contact rail, what maintenance obstructionis will there be for the Kamehameha, Salt Lake, City Center segments?

4.2.8. Systems – Permanent Power, Train Control, Communications

Major Activity/Milestone Forecast Dates:

| | | |
|--|---------|----------------|
| P6-Train Control Advanced Conceptual Eng | 08DEC08 | 06AUG09(8mos) |
| P6-Train Control Final Design | 28JUN10 | 19OCT10(4mos) |
| P6-Train Control Fabrication | 20OCT10 | 09DEC11(14mos) |
| P6-Train Control West Oahu | 23MAY11 | 24MAY13(13mos) |
| P6-Train Control Farrington | 30MAY11 | 11OCT12(22mos) |
| P6-Train Control Yard & Shop | 27JUL11 | 06AUG13(24mos) |
| P6-Train Control Kamehameha | 19MAR14 | 05SEP16(30mos) |

| | | |
|-------------------------------------|---------|----------------|
| P6-Train Control Salt Lake | 17MAR15 | 29DEC17(32mos) |
| P6-Train Control City Center | 04JUL16 | 30NOV18(29mos) |
| P6-Comm&OCC Advanced Conceptual Eng | 24APR09 | 24NOV09(5mos) |
| P6-Comm&OCC Final Design | 05AUG10 | 09AUG11(13mos) |
| P6-Comm&OCC Fabrication | 10AUG11 | 06AUG13(13mos) |
| P6-Comm&OCC West Oahu | 04FEB13 | 30AUG13(7mos) |
| P6-Comm&OCC Farrington | 02APR12 | 26OCT12(7mos) |
| P6-Comm&OCC Yard & Shop | 29OCT12 | 02AUG13(9mos) |
| P6-Comm&OCC Kamehameha- | 04JAN16 | 30SEP16(9mos) |
| P6-Comm&OCC Salt Lake | 01AUG16 | 23MAY17(10mos) |
| P6-Comm&OCC City Center | 13NOV17 | 02OCT18(10mos) |
| Linear-Farrington Train Control | AUG11 | DEC12(17mos) |
| Linear-Farrington Line Opens | | DEC12 |
| Linear-West Oahu Train Control | JUN12 | SEP13(16mos) |
| Linear-West Oahu Line Opens | | SEP13 |

Review Comments:

The duration for the design and construction appears achievable but the 4 months duration for the final design for the Train Control looks aggressive. The Farrington Segment is scheduled to open in December 2012 and the Train Control installation completes on October 2012 (two months difference). The West Oahu Line opens in September 2013 and the Train Control installation completes on May 2013 (three months). The completion of the Train Control have to be finished earlier than currently planned so that static/dynamic testing and pre-revenue operations can be done.

At the Yard & Shop Facility, there are systems equipment required for the facility but also system-wide equipment required for communication with the project-wide system.

Regarding the elevators/escalators, station structure details have to be provided before design work can start and therefore requires coordination with the station designers. The follow-on questions will be:

- Who will be installing the elevators/escalators?. Will it be by the station contractors or by the elevator/escalator installation contractors for all stations?
- Assuming that Yard & Shop Administration Building will have elevators, who will design/install the elevators?

KKCS also notes the schedules do not show interface activities with Hawaiian Electric Co (HECO) for the transmission lines, transformers/switchgears installation at yard & shop, stations, wayside area.

4.2.9. Yard & Shops (Maintenance & Storage Facility)

Major Activity/Milestone Forecast Dates:

| | | |
|--------------------------------|---------|----------------|
| P6-Yard & Shop DB Construction | 25JUN09 | 19OCT12(39mos) |
| P6-Yard & Shop Testing | 26MAR12 | 19OCT12(7mos) |

| | | |
|-------------------------------|-------|--------------|
| Linear-Y&S Site Work | OCT09 | MAY10(8mos) |
| Linear-Y&S Construction | JUN10 | DEC12(31mos) |
| Linear- Farrington Line Opens | | DEC12 |
| Linear-West Oahu Line Opens | | SEP13 |

Review Comments:

The duration for the design and construction appears aggressive and requires further studies for the Yard & Shop Facility as it involves a lot of interfaces with other construction packages. This facility should be ready for operations about six months before the first revenue operation service start for the training of the maintenance staff with the equipment. It should be able to coordinate with OCC facility during testing and revenue operations. Yard & Shop Facility dynamic testing (2-3months) should have at least one rail car available. Based on the above assumptions, the construction of revenue and non-revenue facilities to service rail cars should be completed about nine months before opening of the line. Using the December 2012 revenue service date, the construction of the Yard & Shop Facility should be around March 2012. The earliest projected completion for the Yard & Shop in the three schedules is October 2012. KKCS recommends the City review their planning with regard to the construction sequence.

In the P6 schedule, construction work for the Admin, OCC and Storage Yard starts after the completion of the trackwork. In the case of storage track, the logic makes sense, except for the revenue facilities; structures should be built first and then shop tracks installed. The City should also add design and construction activities for the Operation Control Center, its location and type of facility with equipment.

4.2.10. Train Vehicles

Major Activity/Milestone Forecast Dates:

| | | |
|--|---------|----------------|
| P3-Vehicle Design/Manufacture/Test/Commission | 25APR10 | 18DEC18 |
| P3-System Design/Manufacture/Install/Test/Commission | 25APR10 | 18DEC18 |
| P6-Vehicle NTP | 05OCT10 | |
| P6-Vehicle Engineering | 06OCT10 | 20SEP11(12mos) |
| P6-Vehicle Fabrication - First Delivery | 21SEP11 | 13NOV12(15mos) |
| P6-Vehicle Testing | 14NOV12 | 23JUL13(8mos) |
| P6-Vehicle Fabrication – Remaining Delivery | 01MAR13 | 29JAN15(22mos) |
| P6-Vehicle Testing | 28FEB14 | 28AUG15(18mos) |

Review Comments:

The duration for the contract procurement, design, manufacturing of Rolling Stocks looks aggressive to meet the Farrington Segment and West Oahu Segment revenue service date. Since the P3 CITY (Consolidated) schedule is not detailed enough to provide the delivery of the first batch of the rail cars, the P6 schedule (PE/EIS) was used for the review. In general, it takes about 24 months to deliver the Pilot Vehicle and about 36 months to start the delivery of the production vehicles.

As a result of the review, KKCS identified several areas that require additional clarification:

- The Vehicle Manufacturer has to decide at which facility it will do the final vehicle assembly, testing and then deliver to the Grantee (Honolulu or some other location).
- Will the City allow the Vehicle Manufacturer to use the City's test track for testing?
- Since there is no existing track from the port to the HHCTC track, how will the manufacturer deliver the vehicles?
- Where will the vehicles be sent to, the Yard & Shop facility and/or other locations?
- If the Manufacturer decides to build the final assembly facility in Honolulu, he has to build the final assembly facility, test tracks, and hire skilled workers for assembling cars. Planning assumptions for this scenario need to be understood.
- For dynamic testing which is about 6-8 months before the revenue service and about nine months before the yard & shop facility goes operational, and it needs at least two rail cars for testing. Can the Manufacturer meet the delivery as planned?
- What is the timetable for the delivery of the vehicles? When will the last vehicle be delivered?

4.2.11. System Integration, Dynamic Testing, Pre-revenue Operations

Major Activity/Milestone Forecast Dates:

None

Review Comments:

The system integration, dynamic testing and pre-revenue operations activities are **not** included in the schedules provided; but they are part of the essential components of the project and need to be included. It requires an approximate 9-10 month duration for static testing, dynamic testing and pre-revenue operations. The City needs to determine which contractor will be responsible for the system start-up activities as a part of its project planning.

4.2.12. Revenue Operations

Major Activity/Milestone Forecast Dates:

None

Review Comments:

The current working schedules are all focused with the engineering and construction activities and appears to be neglecting the revenue operations after the lines are open. As HHCTC Project is building the first new rail system in City of Honolulu, there are no experienced operations staff ready to be re-deployed to the new transit line as other major cities' metro line projects. KKCS suggests the City address this issue as a part of its project planning.

5. Conclusion

The three schedules provided by City are at the preliminary planning stage. The schedule depicts an optimistic but achievable revenue service date of December 2018 for the entire alignment. The City is working to fast-track the schedule through a civil/systems design/build delivery for Phase 1, where design and construction are interrelated and iterative while the design is still underway.

Overall, the dates provided in the schedules do not match with each other, ***and the consolidated project schedule as provided on September 21, 2008 is not acceptable as a Project Master Schedule.***

Although the Phase 1 and Phase 2 schedules are mechanically sound, KKCS notes that further development will enhance the Phase 1 schedule's usefulness as a management tool, particularly since durations and the overall schedule are optimistic. KKCS also suggests the addition of more detailed activities and relationship ties, especially in the final design and construction phases.

The City should start working on a Master Schedule which should incorporate all of the schedule activities in the three schedules and provide uniform schedule data information. The schedule needs further technical development in order to provide a sound basis to manage the project to these very tight durations. These include:

- Use the same scheduling software for the Master Program Schedule and the individual schedules used by the city, consultants, and contractors.
 - KKCS recommends using Primavera P6 software for all who are involved and providing schedule information to the Master Program Schedule.
- Develop a Contract Implementation Plan (CIP) which will identify and describe the contract packages and provides the framework for the execution of design, procurement and construction in the HHCTC project.
- Assure a project schedule development and implementation procedure is developed and implemented by all staff/consultants.
- The PMOC/FTA review and approval processes and duration are not clearly depicted in the schedules.
- Identify clear relationship ties between land acquisition, utility relocation, DMU vehicle procurement, civil/systems D/B, station final design and construction. This effort will also result in the identification of additional critical path items.
- Inclusion of activities and milestones for system start-up, testing, pre-revenue operations, and the revenue operation date.

- Inclusion of a minimum nine month duration for system start-up activities such as system integration, dynamic testing and pre-revenue operations
- Additional detailing of guideways, stations and systems construction activities.
- Inclusion of duration contingencies to address further activity detailing as the design and construction phases progress, without impacting to the Revenue Operations Date.
- Include additional detail for long-lead Owner furnished equipment and material.
- A logic driven schedule (versus a constraint/open-end ties schedule) is a necessary tool to manage this overall aggressive schedule to a successful conclusion.

Areas of risks are noted in detail within this report. In terms of risk management, KKCS suggests that a project-wide coordination team that is knowledgeable in rail construction and operations be assigned to coordinate the project. This will facilitate a better working relations and communication especially between the schedule-critical civil, guideways, stations and systems design consultants. The following are some of the measures that could help reduce risk to the schedule:

- Assign a project-wide coordination team knowledgeable in rail construction and operations to coordinate the project during design, construction and start-up phases.
- Timely procurement of the major real estate parcels and avoid going through condemnation process.
- Coordination with utility companies to relocate critical utility lines before construction starts.
- Timely procurement of the vehicles required for the testing and opening of the Farrington Line service.
- Regular design coordination meetings with civil, guideways, station and system engineers to flush out design/coordination issues especially for the initial design/build contracts in Phase 1.
- Complete guideways, stations and and systems work earlier than planned, allowing more time for system integration, dynamic testing, and pre-revenue operations.
- As the project duration is over 10 years, there should a contingency plan for price increases for material and labor.

APPENDIX A – Major Activity/Milestone Forecast Dates

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| P3 schedule filename: CITY | Start | Finish | |
|---|---------|---------|------|
| Dur(CD) | | | |
| FTA Approves PE | | 31DEC08 | |
| Prep LONP Request Part 2 DB Gway/MSF/Systems | 16SEP08 | 15OCT08 | 30 |
| DB MSF Project Documents | 14JAN09 | 30JAN09 | 17 |
| Preliminary Engineering DB Guideway | 31DEC08 | 13FEB09 | 45 |
| Preliminary Engineering MSF | 31DEC08 | 29APR09 | 120 |
| New Starts Preliminary Engineering | 31DEC08 | 26DEC09 | 361 |
| Issue Record of Decision | | 28AUG09 | |
| Prepare Part1 DB RFP MSF | 16SEP08 | 29SEP08 | 14 |
| Issue NTP 2 DB MSF | 01MAR10 | | |
| Prepare Part 1 DB RFP Guideway | 16SEP08 | 29SEP08 | 14 |
| Issue NTP 2 DB Guideway for Constr | 17JAN10 | | |
| Prepare Part 1 DB RFP Systems | 16SEP09 | 29SEP08 | 14 |
| Issue NTP 2 DB Systems | 25APR10 | | |
| FTA approve Entry to Final Design | 29AUG09 | 26DEC09 | 120 |
| FFGA Application | 26APR10 | 25MAY10 | 30 |
| FTA Award FFGA | 20FEB11 | | |
| Vehicle Design/Manufacture/Test/Commission | 25APR10 | 18DEC18 | 3160 |
| System Design/Manufacture/Install/Test/Commission | 25APR10 | 18DEC18 | 3160 |
| Open Farrington Section | | 15DEC12 | |
| Complete MSF DB Contract | 01MAR10 | 08APR14 | 1500 |
| West Oahu Stations Construction | 17JAN12 | 16APR14 | 821 |
| Farrington Stations Construction | 23MAR11 | 10APR14 | 1430 |
| West Oahu/Farrington Gway DB Contract | 17JAN10 | 16MAR12 | 790 |
| Open East Kapolei Pearl Highlands | | 16APR14 | |
| Open to Aloha Stadium | | 16MAR17 | |
| Open to Ala Moana Center | | 18DEC18 | |
| P6 schedule filename: Salt Lake Constr | Start | Finish | |
| Dur(WD) | | | |
| Record of Decision | | 19AUG09 | |
| Full Funding Agreement | | 01FEB11 | |
| Right of Way Acquisition | 17AUG08 | 22DEC11 | 603 |
| Vehicle NTP | 05OCT10 | | |
| Vehicle Engineering | 06OCT10 | 20SEP11 | 247 |
| Vehicle Fabrication - First Delivery | 21SEP11 | 13NOV12 | 300 |
| Vehicle Testing | 14NOV12 | 23JUL13 | 180 |
| Vehicle Fabrication – Remaining Delivery | 01MAR13 | 29JAN15 | 500 |
| Vehicle Testing | 28FEB14 | 28AUG15 | 240 |
| West Oahu Station Construction | 01JUL11 | 30AUG13 | 588 |
| Farrington Station Construction-WestLoch&Pearl High | 01FEB11 | 30AUG13 | 674 |

| | | | |
|--|---------|---------|-----|
| City Center Station Group Construction | 02MAR15 | 30NOV18 | 980 |
| Kamehameha Segment Utility Work/Relocation | 01FEB11 | 30MAR12 | 304 |
| Salt Lake Segment Utility Work/Relocation | 01MAR11 | 28JUN13 | 609 |
| West Oahu Guideway DB Construction | 09OCT09 | 02DEC11 | 551 |
| West Oahu Revenue Service | | 13SEP13 | |
| Farrington Guideway DB Construction | 14SEP09 | 26AUG11 | 500 |
| Farrington Revenue Service | | 24DEC12 | |
| Yard & Shop DB Construction | 25JUN09 | 19OCT12 | 855 |
| Yard & Shop Testing | 26MAR12 | 19OCT12 | 150 |
| Kamehameha Seg Advanced Concept Eng | 23JUL09 | 20AUG10 | 275 |
| Kamehameha Seg Final Design | 23AUG10 | 25AUG11 | 260 |
| Kamehameha Seg Sitework/Earthwork | 01FEB11 | 31OCT11 | 195 |
| Kamehameha Seg Guideway Construction | 09DEC11 | 05DEC14 | 781 |
| Kamehameha Seg Testing | 23DEC15 | 02AUG16 | 160 |
| Kamehameha Seg Revenue Service | | 07NOV16 | |
| Salt Lake Seg Advanced Concept Eng | 25AUG09 | 08JUN10 | 200 |
| Salt Lake Seg Final Design | 24SEP10 | 27SEP11 | 260 |
| Salt Lake Seg Sitework/Earthwork | 01MAR11 | 21SEP12 | 409 |
| Salt Lake Seg Guideway Construction | 01OCT12 | 30JUN16 | 979 |
| Salt Lake Seg Testing | 18SEP17 | 27APR18 | 160 |
| Salt Lake Seg Revenue Service | | 30APR18 | |
| City Center Seg Advanced Concept Eng | 26AUG10 | 27JUN11 | 214 |
| City Center Seg Final Design | 11OCT11 | 08OCT12 | 260 |
| City Center Seg Sitework/Earthwork | 11OCT11 | 13MAY13 | 415 |
| City Center Seg Guideway Construction | 07MAR13 | 01NOV16 | 953 |
| City Center Seg Testing | 28MAR18 | 06NOV18 | 160 |
| City Center Seg Revenue Service | | 24DEC18 | |
| Trackwork Advanced Conceptual Eng | 08DEC08 | 06AUG09 | 170 |
| Trackwork Final Design | 28JUN10 | 19OCT10 | 80 |
| Trackwork Fabrication | 20OCT10 | 09DEC11 | 295 |
| Trackwork West Oahu | 02JAN12 | 31AUG12 | 175 |
| Trackwork Farrington | 04APR11 | 30DEC11 | 195 |
| Trackwork Yard & Shop | 16JUL12 | 08FEB13 | 150 |
| Trackwork Kamehameha | 01OCT13 | 25NOV14 | 300 |
| Trackwork Salt Lake | 25NOV14 | 29FEB16 | 329 |
| Trackwork City Center | 29FEB16 | 26JUN17 | 345 |
| Traction Power Advanced Conceptual Eng | 08DEC08 | 06AUG09 | 170 |
| Traction Power Final Design | 28JUN10 | 19OCT10 | 80 |
| Traction Power Fabrication | 20OCT10 | 09DEC11 | 295 |
| Traction Power West Oahu | 27FEB12 | 12APR13 | 295 |
| Traction Power Farrington | 30MAY11 | 11OCT12 | 359 |
| Traction Power Yard & Shop | 09MAR12 | 12JUL13 | 350 |
| Traction Power Kamehameha | 25DEC13 | 16SEP16 | 712 |
| Traction Power Salt Lake | 20JAN15 | 16FEB18 | 803 |
| Traction Power City Center | 29FEB16 | 16NOV18 | 709 |

| | | | |
|---------------------------------------|---------|---------|-----|
| Train Control Advanced Conceptual Eng | 08DEC08 | 06AUG09 | 170 |
| Train Control Final Design | 28JUN10 | 19OCT10 | 80 |
| Train Control Fabrication | 20OCT10 | 09DEC11 | 295 |
| Train Control West Oahu | 23MAY11 | 24MAY13 | 525 |
| Train Control Farrington | 30MAY11 | 11OCT12 | 359 |
| Train Control Yard & Shop | 27JUL11 | 06AUG13 | 530 |
| Train Control Kamehameha | 19MAR14 | 05SEP16 | 643 |
| Train Control Salt Lake | 17MAR15 | 29DEC17 | 808 |
| Train Control City Center | 04JUL16 | 30NOV18 | 630 |
| Comm&OCC Advanced Conceptual Eng | 24APR09 | 24NOV09 | 150 |
| Comm&OCC Final Design | 05AUG10 | 09AUG11 | 260 |
| Comm&OCC Fabrication | 10AUG11 | 06AUG13 | 520 |
| Comm&OCC West Oahu | 04FEB13 | 30AUG13 | 150 |
| Comm&OCC Farrington | 02APR12 | 26OCT12 | 150 |
| Comm&OCC Yard & Shop | 29OCT12 | 02AUG13 | 200 |
| Comm&OCC Kamehameha | 04JAN16 | 30SEP16 | 195 |
| Comm&OCC Salt Lake | 01AUG16 | 23MAY17 | 212 |
| Comm&OCC City Center | 13NOV17 | 02OCT18 | 232 |
| HHCTC Linear Schedule 3 | Start | Finish | |
| <u>Dur(Mo)</u> | | | |
| ROD | | SEP09 | |
| Y&S Site Work | OCT09 | MAY10 | |
| Y&S Construction | JUN10 | DEC12 | |
| Farrington Guideways | OCT08 | SEP11 | |
| Farrington Stations | JUL11 | SEP13 | |
| Farrington Trackwork | FEB11 | NOV11 | |
| Farrington Traction Power | FEB11 | SEP12 | |
| Farrington Train Control | AUG11 | DEC12 | |
| Farrington Line Opens | | DEC12 | |
| West Oahu Guideways | NOV08 | DEC11 | |
| West Oahu Stations | SEP11 | SEP13 | |
| West Oahu Trackwork | NOV11 | AUG12 | |
| West Oahu Traction Power | FEB12 | JUN13 | |
| West Oahu Train Control | JUN12 | SEP13 | |
| West Oahu Line Opens | | SEP13 | |
| Kamehameha Final Design | APR10 | JAN11 | |
| FFGA | | FEB11 | |
| Kamehameha Advance Utility Work | FEB11 | AUG12 | |
| Kamehameha Guideways | OCT11 | DEC14 | |
| Kamehameha Stations | AUG14 | SEP16 | |
| Kamehameha Trackwork | FEB14 | MAR15 | |
| Kamehameha Traction Power | APR15 | APR16 | |
| Kamehameha Train Control | AUG15 | OCT16 | |
| Kamehameha Line Opens | | NOV16 | |

| | | |
|----------------------------------|-------|-------|
| Salt Lake Final Design | MAY10 | MAR11 |
| Salt Lake Advance Utility Work | MAR11 | JUN13 |
| Salt Lake Guideways | NOV11 | DEC14 |
| Salt Lake Stations | SEP15 | MAY18 |
| Salt Lake Trackwork | MAR15 | MAY16 |
| Salt Lake Traction Power | AUG16 | JUL17 |
| Salt Lake Train Control | FEB17 | MAY18 |
| Salt Lake Line Opens | | MAY18 |
| City Center Final Design | OCT10 | JUL11 |
| City Center Advance Utility Work | AUG11 | MAR14 |
| City Center Guideways | MAR13 | OCT18 |
| City Center Stations | JUN15 | DEC18 |
| City Center Trackwork | JUN16 | OCT17 |
| City Center Traction Power | NOV17 | AUG18 |
| City Center Train Control | MAY18 | DEC18 |
| City Center Line Opens | | DEC18 |